

ABSTRACT

A chromium-containing half-tone phase-shift photomask comprising coarse and dense patterns coexisting in a plane is prepared by a series of pattern-forming steps including forming a resist layer on a photomask blank, exposing and patterning said resist layer, developing, etching said photomask blank and removing said resist layer. Patterns for transferring onto a wafer are formed on the photomask blank by a dry-etching method comprising dry-etching a chromium-containing half-tone phase-shift film utilizing etching gas comprised of mixed gas including (a) reactive ion etching gas, containing an oxygen-containing gas and a halogen-containing gas, and (b) reducing gas added to the gas component (a). The dry-etching method permits production of a half-tone phase-shift photomask comprising coarse and dense portions coexisting in a plane, the dimensional difference therebetween being considerably eliminated when patterns to be transferred to a wafer are formed on a photomask blank for a chromium-containing half-tone phase-shift mask ~~dry-etching method comprises the step of dry-etching a metal thin film as a chromium-containing half-tone phase-shift film, wherein the method is characterized by using, as an etching gas, a mixed gas including (a) a reactive ion etching gas, which contains an oxygen-containing gas and a halogen-containing gas, and (b) a reducing gas added to the gas component (a), in the process for dry-etching the metal thin film. The dry-etching method permits the production of a half-tone phase-shift photomask by forming patterns to be transferred to a wafer on a photomask blank for a chromium-containing half-tone phase-shift mask. The photomask can~~

in turn be used for manufacturing semiconductor circuits. The method permits the decrease of the dimensional difference due to the coexistence of coarse and dense patterns in a plane and the production of a high precision pattern etched product.